

## Grenadiers (Gadiformes, Teleostei) of Walters Shoals, Southwestern Indian Ocean, with Description of a New “West-Wind Drift” Species

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During cruise 17 of the *Vityaz'*, numerous specimens of a new species of *Caelorinchus*, *C. vityazae*, were collected off Walters Shoals in the Indian Ocean south of Madagascar. The new species is here described from 32 specimens collected at five different localities within the southeastern Atlantic and southwestern Indian Ocean in the biogeographical area defined by Collette and Parin (1991) as the West Wind Drift Island Province. *Caelorinchus vityazae* is a member of the *C. fasciatus* species group whose 14 members are confined primarily to temperate waters of the southern hemisphere, with most species found off Australia and New Zealand. The new species can be distinguished from others of the clade by the combination of having 10-II prominent saddle marks, a naked underside of head, and a sharply pointed terminal snout scute. Of the 22 other species of grenadiers recorded from Walters Shoals, most are widespread in the southern hemisphere or circumglobal.

Collette and Parin (1991) reported on the shallow-water fishes of Walters Shoals, an oceanic seamount about 400 nautical miles south of Madagascar they considered as one of a chain of seven islands and seamounts having close faunal affinities. The chain stretches from Gough Island in the South Atlantic to Amsterdam and St. Paul islands in the southern Indian Ocean; most of the chain lies along the edge of the relatively stable eastward-flowing subantarctic surface current called the West Wind Drift (WWD). In recognition of the faunal affinities within the chain, Collette and Parin named the area West Wind Drift Islands Province.

The Soviet research vessel *Vityaz'* occupied a series of deepwater bottom-trawl stations off Walters Shoals during cruise 17, the same cruise on which Collette and Parin made their shallow-water collections. Parin et al. (1993) have reported on fish and invertebrate from the Shoals. Among the fishes, they recorded 19 species of grenadiers taken at depths between 525 and 2050 m. One of grenadiers collected from Walters Shoals represents an undescribed species of *Caelorinchus* that is known only from collections made at five localities within the WWD Island Province: it appears to represent a species endemic to that province. A number of other Walters Shoals grenadiers have distributions that coincide with the circumglobal boundaries of the West Wind Drift, which suggests that whatever physical, chemical, biological, or other factors that define the limits of the water mass have an affect on the distribution of these grenadiers.

We provide here a description of the new *Caelorinchus* and a list of other grenadiers taken on Walters Shoals, along with comments on their distributions.

## MATERIALS AND METHODS

Most of the specimens reported here were provided through the courtesy of N. V. Parin, chief scientist for the 1988–89 *Vityaz* cruise 17 to Walters Shoals. The grenadiers received by the California Academy of Sciences (CAS) from that cruise were collected mostly by M. E. Anderson and the second author (YNS). Other specimens of the new species were examined through the courtesy of curators at LACM, MNHN, USNM, ZISP, and ZMMGU. Abbreviations for museum depositories follow Leviton et al. (1985 and 1988) except for the P. P. Shirshov Institute of Oceanology, Russian Academy of Sciences, formerly IOAN, now IORAS, and the Zoological Institute of the Russian Academy of Sciences, formerly ZIL, now ZISP. The reader is referred to Iwamoto (1990a) and Iwamoto and Merrett (1997) for generic diagnoses and species synonymies; complete reference citations to original descriptions of the genera and species treated here are available in Eschmeyer's *Catalog of Fishes* (1998).

Counts and measurements were taken following procedures established for grenadiers by Gilbert and Hubbs (1916), and later modified by Iwamoto (1970) and Iwamoto and Sazonov (1988). In the Specimens Examined section for all species other than the new *Caelorinchus*, the museum catalog number is followed in parentheses by the number of specimens and the range in size in mm head length (HL) or mm total length (TL), or both. For *Vityaz* collections, only the station number and depth of capture are given, but additional collection information is provided in Table 1.

TABLE 1. Abbreviated data set for stations at which grenadiers were captured on Walters Shoals during *Vityaz* cruise 17.

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sta. 2668; 33°1.2'S, 44°36.8'E; 1010 m; 8 Dec. 1988.
sta. 2670; 33°01.6'S, 44°49.2'E; 1100–1090 m; 8–9 Dec. 1988.
sta. 2671; 32°55'S, 45°00'E; 1200–1175 m; 12 Dec. 1988.
sta. 2672; 32°53'00S, 45°11'30"E; 1310–1265 m; 9 Dec. 1988.
sta. 2673; 32°45'S, 45°30'E; 1750–1700 m; 12 Dec. 1988.
sta. 2674; 33°16'42"S, 43°41'05"E; 900–920 m; 12 Dec. 1988.
sta. 2686; 33°04'12"S, 43°52'05"E; 653–660 m; 12 Dec. 1988.
sta. 2706; 33°1'00"S, 44°30'00"E; 970–980 m; 15 Dec. 1988.
sta. 2707; 33°1'48"S, 44°23'36"E; 910–925 m; 15 Dec. 1988.
sta. 2708; 33°07.5'S, 44°04.0'E, 785–760 m; 15 Dec. 1988.
sta. 2721; 33°25'18"S, 43°37'30"E; 1000–1030 m; 12 Dec. 1988.
sta. 2735; 33°36'00"S, 44°32'00"E; 930–950 m; 19 Dec. 1988.
sta. 2736; 33°58'06"S, 45°01'00"E; 1030–1050 m; 19 Dec. 1988.
sta. 2742; 34°41'48"S, 45°28'00"E; 1518–1750 m; 20 Dec. 1988.
sta. 2764; 33°16'42"S, 43°41'00"E; 920–900 m; 24 Dec. 1988.
sta. 2765; 33°09'S, 43°41'E; 870–880 m; 24 Dec. 1988.
sta. 2772; 31°59'00"S, 45°11'00"E; 1950–2050 m; 25 Dec. 1988.

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## WALTERS SHOALS GRENADIERS

Fifteen species of bathygadid and macrourid grenadiers were captured on Walters Shoals during *Vityaz* cruise 17. Two species of *Caelorinchus* could not be identified with any known species; one of these is here described as new, the other requires further study and comparison with other specimens before it can be described. Other vessels have collected grenadiers on Walters Shoals, including the former Soviet vessels *Zvezda Kryma* (in 1976 and 1977) and *Professor Mesiatzev* (in 1979), and the French vessel *RV Marion Dufresne* (in 1976). They recorded seven other grenadiers,

giving a total of 22 species known from Walters Shoals. Five of the 22 (*Cetonus globiceps*, *Coryphaenoides armatus*, *Kuronezumia bubonis*, *Malacocephalus laevis*, and *Odontomacrus murrayi*) are circumglobal in distribution, but most of the remainder are widespread southern hemisphere species.

### Family Bathygadidae

#### 1. *Bathygadus cottoides* Günther, 1878

**SPECIMENS EXAMINED.**— IORAS 167 (2 spec.); *Vityaz* sta. 2671, 1200–1175 m. IORAS uncat. (4 specimens, 105–210 mm TL); *Vityaz* sta. 2672, 1310–1265 m. IORAS 169 (35, 73–163 TL); *Vityaz* sta. 2673, 1750–1700 m. IORAS 521 (1, 129 TL), *Vityaz* sta. 2674, 1500–1600 m. IORAS uncat. (14, 137–205 TL); *Vityaz* sta. 2742, 1518–1750 m. IORAS 170 (1 spec.); *Vityaz* sta. 2748, 765–750 m.

**DISTRIBUTION.**— South Africa east to Australia and New Zealand; depth range about 1000–1600 m (Iwamoto and Anderson, 1994:3–4; Iwamoto and Graham, 2001:421).

#### 2. *Bathygadus favosus* Goode and Bean, 1886

**SPECIMENS EXAMINED.**— IORAS uncat. (1, 430 TL); CAS 66517 (1, 75.2 HL, 413+ TL); *Vityaz* sta. 2672, 1310–1265 m.

**DISTRIBUTION.**— North Atlantic and southeast Atlantic from Gulf of Guinea south to Cape Town, South Africa; depth range from 768–2745 m (Iwamoto 1970:348; Iwamoto and Anderson 1994:5).

#### 3. *Gadomus capensis* (Gilchrist and von Bonde, 1924)

**SPECIMENS EXAMINED.**— IORAS uncat. (6 spec.); CAS 66519 (5 spec.); *Vityaz* sta. 2668, 1010 m. IORAS uncat. (86, 180–370 TL); *Vityaz* sta. 2670, 1100–1090 m. IORAS 526 (6, 240–410 TL); *Vityaz* sta. 2671, 1200–1175 m. CAS ex66517 (28.5 HL, 195 TL); *Vityaz* sta. 2672; 1310–1265 m. IORAS 1743 (1 spec.); *Vityaz* sta. 2706, 970–980 m. IORAS uncat. (2 spec.), CAS 66519 (5 spec.); *Vityaz* sta. 2736, 1030–1050 m. IORAS 531 (1 spec.); *Vityaz* sta. 2742, 1750–1800 m.

**DISTRIBUTION.**— Southern Africa, from Table Bay to Mozambique; Madagascar Plateau; Walvis Ridge, se. Atlantic; in 850–1480 m (Iwamoto and Anderson 1994:5).

### Family Macrouridae

#### 4. *Asthenomacrus victoris* Sazonov and Shcherbachev, 1982

**DISTRIBUTION.**— Indian Ocean, Japan, and Australia, in about 1650–3500 m (Iwamoto and Graham, 2001).

**REMARKS.**— Recorded by Parin et al. (1993), but no specimens from *Vityaz* cr. 17 were available for examination.

#### 5. *Caelorinchus vityazae* Iwamoto, Shcherbachev, and Marquardt, sp. nov.

(Figs. 1–2)

“*Caelorinchus* sp. *sensu* Iwamoto and Anderson, 1994”: Duhamel, 1999: tables 1 and 2.

**SPECIMENS EXAMINED.**— HOLOTYPE: CAS 66493 (64 mm HL, 277 mm TL); 33°16'42"S, 43°41'00"E, 900–920 m, *Vityaz* cr. 17, sta. 2764, 24 Dec. 1988. PARATYPES (33 specimens): **Indian**

**Ocean: Walters Shoals:** IORAS 179 (4 spec.), CAS 66494 (3, 46–55 HL); *Vityaz* sta. 2686, 650–660 m. IORAS 174279 (1 spec.); *Vityaz* sta. 2706, 980 m. CAS 66485 (69 HL, 269 TL); *Vityaz* sta. 2707, 910–925 m. IORAS 529 (1 spec.); *Vityaz* sta. 2670, 1600–2000 m. IORAS 1741 (1 spec.); *Vityaz* sta. 2733, 1100–1090 m. USNM 307860 (7, 53–74 HL); *Vityaz* sta. 2735, 850–740 m. CAS 218975 (2, 67–69 HL); same data as for holotype. LACM 44770-1 (1, 56.2 HL, 230 mm TL); *Vityaz* sta. 2708, 785–760 m. MNHN 2000–1476 (2, 17.5–48.2 HL, 85–188+ TL); 33°11.4'S, 44°00.4'E, 620–635 m, *Marion Dufresne* cr. MD08, sta. 6, CP47, 16 March 1976. **Southwest Indian Ridge:** MNHN 1996-228 (1, 71.9 HL, 310 TL); 41°24'S, 42°54'E, 556–440 m, *Kerguelen de Tremarec*, 26 Feb 1996. **Amsterdam and St. Paul Islands:** MNHN 1989-1139 (1, 48.7 mm HL, 185+ mm TL); 38°48.65'S, 77°36.14'E, 410–450 m, *Marion Dufresne* cr. 50, CP 209, sta. H22, 18 July 1986. MNHN 1989-1140 (1, 42.4 HL, 181 TL); 38°38'S, 77°29'E, 510–485 m, *Marion Dufresne* cr. 50, sta. 33, CP 149, 22 Jul 1986. **South Atlantic: Discovery Tablemount:** ZMMGU P-15650 (3, 39–44 HL); 42°30.5'S, 01°33'W, 400 m, *Prof. Mesiatzev* cr. 8, trawl 155, 10 Dec. 1979. **Bank Gulf:** ZISP uncat. (11, 49.0–68.5 HL); 39°37'S, 06°38.2'W, *Evrika* cr. 3, 190–335 m.

**DIAGNOSIS.**—A species of *Caelorinchus* with the following combination of characters: snout moderate (orbit diameter 0.88–1.16 into snout length), tipped with a sharp terminal scute, area dorsally behind leading edge of snout fully scaled, anterolateral margin of snout incompletely supported by bone; underside of head naked; body scales between origin of second dorsal fin and lateral line with 9–13 parallel rows of small, slender spinules; anterior dermal window of light organ short, extending forward about midway between anal-fin origin and pelvic-fin insertion; swim bladder deeply bilobed anteriorly; a distinctive banding pattern along body.

**DESCRIPTION OF HOLOTYPE** (paratype data in parentheses).—Head length about 25% total length (23–34%), about 1.5 times (1.5–1.8) greatest body depth. Width of body across pectoral bases about 75% (60–80%) greatest body depth. Snout tipped with a short but sharply pointed scute. Snout length greater than postorbital length, 1.9 times (1.6–2.0) interorbital width. Orbit large, elliptical, 1.7 times (1.6–2.0) broad, flat interorbital region. Subopercle terminates ventrally in slender tip that extends slightly beyond preopercle. Interopercle completely hidden behind preopercle. Upper jaw extends posteriorly to below middle of orbit. Mouth relatively small, rictus restricted posteriorly by lip folds; lips thick. Chin barbel short, slender, about one-third of orbit. Gill membranes broadly connected to isthmus, without a free posterior fold. Upper margin of operculum completely restricted by membrane; opercular opening ventrally extends forward to below posterior portion of preopercle.

Teeth all small, in bands in both jaws. Premaxillary band short and broad, its length approxi-

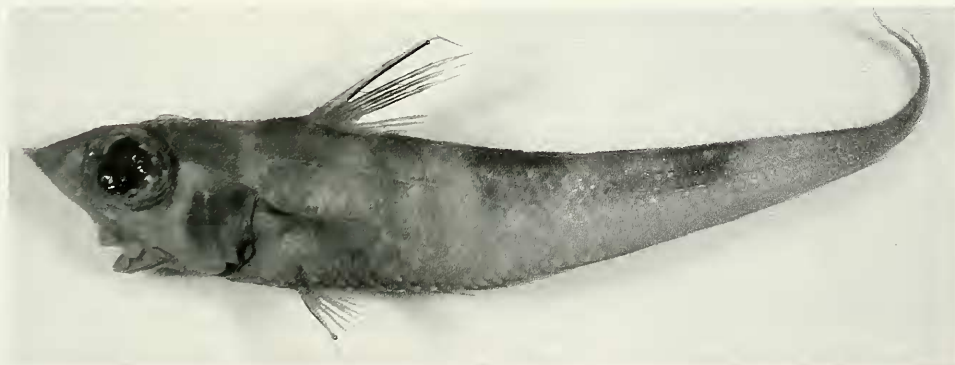


FIGURE 1. *Caelorinchus vityazae* sp. nov. Lateral view of paratype (CAS 66494, 54.8 mm HL, 212+ mm TL), from Walters Shoals, captured at a depth of 653–660 m.

mately 40% length upper jaw (30–50%); outer series of teeth slightly enlarged. Dentary band narrower, longer, and tapered posteriorly, about equal to rictus length.

First dorsal fin height about two-thirds head length; length of base about equal to interspace between first and second dorsal fins. Leading edge of second spinous ray smooth, its tip thin, extending slightly beyond adjacent segmented ray. Pectoral fin extends posteriorly to above anal-fin origin. Outer ray of pelvic fin with filamentous distal tip, extending posteriorly to above second ray of anal fin.

Body scales large and adherent, large scales below origin of second dorsal fin covered with 9–11 (9–13) parallel rows of short slender spinules. Predorsal scales with slightly elevated medial ridge of spinules and differing in that manner from other body scales. Ridges on head marked by stout, coarsely spinulated modified scales. Underside of head completely naked. Area dorsally behind both leading horizontal edges of snout fully covered with small spiny scales. Nasal fossa mostly scaly, but small naked area anteriorly with a thin anteroventral naked strip connecting to suborbital ridge. Suborbital ridge formed of stout, coarsely spined scales, with two rows of stout scales extending from below anterior margin of orbit to end of preopercle.

Pyloric caeca slender, short, length of longest about two-thirds of orbit diameter, 18 total (12–19,  $x = 16.2$ ,  $n = 6$ ). Light organ relatively small, length about  $\frac{1}{3}$ ths of orbit diameter, located immediately anterior to anus. Anterior dermal window of light organ in shallow, narrow depression before anus, extending forward to about midway between anal-fin origin and pelvic-fin insertion, not reaching pelvic girdle. Swim bladder large, separated by a narrow constriction into anterior and posterior chambers, the anterior chamber divided by a deep medial cleft forming two large lobes, with each lobe containing two gas glands each connected to a short, broad rete.

Color. As many as 11 saddle markings along dorsal half of body. First, third, fifth, and seventh saddles most prominent. Markings fade ventrally (generally more prominent in smaller individuals). Abdominal region bluish-black, color extending from above anterior portion of anal fin to region of pectoral and pelvic fins, but not along shoulder girdle and anteriorly on chest. Head relatively pale save the following: gill cover blue-black, most anterior rim of orbit dark (dark pigment encircling orbit in some, mostly younger, specimens, although darkest and most distinct along anterior margin); inside of mouth and anterior portion of lips blue-black. Underside of head pale to light dusky (dark dusky near tip of snout in some paratypes). Pectoral fin dusky, pale at base. First dorsal fin uniformly dark dusky except for long spinous ray, which is white (blackish in some smaller paratypes, dark to base in some, with thin pale basal margin in others). Pelvic fin uniformly light dusky except outer ray white (some paratypes with darker rays). Anal fin dusky anteriorly, becoming paler posteriorly. Lips pale, gums dark.

Counts and measurements (holotype first, followed by range in paratypes in parenthesis). 1D. 11,8 (11,8–10); P. i15(i14–i19, usually i15–i18); V.7. Scales below origin of 1D. 4.5 (4.5–5.5); below middle of 1D. 4.5 (3.5–4.5); below origin of 2D. 4.5 (4.0–4.5); lateral line scales over distance equal to predorsal length 25 (24–30). Gill rakers first arch (mesial) 2+6 (8–10 total); second arch (lateral) 0+7 (6–8 total), (mesial) 2+6 (8–10 total).

Total length 269 mm (85–320 mm); head length 69 mm (17.5–76.8 mm). Following in percent of head length: snout length 38 (33–38); preoral length 32 (31–38); internasal width 22 (21–26); interorbital width 20 (19–23); orbit diameter 33 (33–40); suborbital width 18 (15–18); postorbital length 32 (26–32); orbit to preopercle distance 33 (27–36); upper jaw length 27 (24–30); premaxillary teeth-band length 7 (6–13); barbel length 10 (7–13); first gill-slit length 12 (11–16); preanal length 147 (137–163); outer pelvic ray to anal-fin origin 43 (33–47); body depth 63 (55–67); body width at pectoral base 58 (45–63); interspace between 1D. and 2D. 20(15–29); height 1D. 62 (58–77); length P. 49 (46–59); length V. 46 (37–58); length anterior dermal window 7 (4–10)

**ETYMOLOGY.**— Named after the research vessel *Vityaz* on which many of the type specimens were captured.

**DISTRIBUTION.**— Endemic to the West Wind Drift Islands Province; known from Bank Gulf and Discovery Tablemount in the South Atlantic, and Walters Shoals and St Paul and Amsterdam islands in the western Indian Ocean. Depth range 653–950 m.

**COMPARISONS.**— *Caelorinclus vityazae* is one of 14 spp. belonging to a clade that we call the *C. fasciatus* group. Species in the group share the following combination of characters: (1) snout short, usually blunt, its leading margin when viewed from above usually forming an obtuse angle in most species, its length about equal to or (usually) shorter than large orbit; (2) lateral and medial processes of nasal bone not connected laterally (“anterolateral margin not supported by bone”); (3) a well-developed fossa of light organ immediately anterior to anus, extending forward, depending on species, to midway between anus and pelvic fins, to as far forward as slightly beyond bases of pelvic fins (e.g., *C. mirus*); (4) body scales large, with 12 to more than 20 parallel rows of small spinules in largest scales of adults; (5) swim bladder divided into a single posterior chamber and a deeply bilobed anterior chamber; (6) prominent multiple saddle bands along body in most species. Species in the group include: *C. amydrozosterus* Iwamoto and Williams, 1999, *C. aspercephalus* Waite, 1911, *C. australis* Richardson, 1839, *C. biclinozonalis* Arai and McMillan, 1982, *C. bollonsi* McCann and McKnight, 1980, *C. cookianus* McCann and McKnight, 1980, *C. fasciatus* (Günther, 1878), *C. maurofasciatus* McMillan and Paulin, 1993, *C. mirus* McCulloch, 1926, *C. mystax* McMillan and Paulin, 1993, *C. parvifasciatus* McMillan and Paulin, 1993, *C. simorhynchus* Iwamoto and Anderson, 1993, an undescribed species from Western Australia, and the new species here described.

*Caelorinclus aspercephalus*, *C. australis* and *C. biclinozonalis* also have a relatively pointed snout like that of the new species, but they differ, among other characters, in having a scaly underside of head and much different body markings (faint oblique saddles directed slightly anteroventrally in *C. aspercephalus*, thin horizontal stripes in *australis* and only two saddle marks in *biclinozonalis*). The other remaining species of the group have the tip of the snout armed with a coarse, blunt, trifid scale; in the new species the terminal scute consists of a somewhat-elongate, sharp, medial prong flanked by much smaller, blunt prongs (Fig. 2); as a consequence of the elongate medial prong, the snout viewed dorsally forms an acute angle, rather than an obtuse one. Additionally, *C. simorhynchus* lacks saddle markings; *C. bollonsi* has saddles in specimens less than about 30 cm, but lacks them in adults; it also has a black anal fin, small patches of scales on the underside of the head above the lower jaw articulation, and 27–38 pyloric caeca (characters from McMillan and Paulin 1993:827). *Caelorinclus parvifasciatus* has faint saddle marks posteriorly on the tail, the dorsal surface of the snout behind the leading edge usually has a naked area on both sides, and the pyloric caeca count is 22–28. The unusually large fossa of the light organ in *C. mirus*, and the black spots on the pelvic fin and on the base of the pectoral fin are distinctive for that species. In *C. cookianus* the saddles are uniformly dark and there are slight differences from the new species in the shape of the pale



FIGURE 2. *Caelorinclus vityazae* sp. nov. Dorsal view of head of paratype (CAS 66494, 54.8 mm HL), showing shape of snout and details of terminal scute.

interspaces; the pyloric caeca count of 19–27 (*vide* McMillan and Paulin 1993:827) is also slightly higher. *Caelorinchus maurofasciatus* and *C. fasciatus* are closely similar in appearance and morphometry to the new species, but differ slightly in pigmentation of the dorsal and anal fins and in the shape and prominence of the saddle marks on the body. *C. amydrozosterus* has a clear naked area on each side of the dorsal snout surface, saddle markings that are oriented in the opposite direction, and a larger dermal window of the light organ. *Caelorinchus mystax* has a deep, blunt snout, anal fin with a black distal margin, and more than 100 pyloric caeca.

#### 6. *Caelorinchus karrerae* Trunov, 1984

**SPECIMENS EXAMINED.**— IORAS 1779 (1 spec.); *Vityaz* sta. 2670, 1100–1090 m. CAS 66486 (10, 52–65 HL, 236–275 TL); *Vityaz* sta. 2668, 1010 m. CAS 66488 (10, 53–63 HL, 220+–271 TL); *Vityaz* sta. 2670, 1100–1090 m. IORAS 1744 (1 spec.); *Vityaz* sta. 2706, 980 m. CAS 66490 (14, 21–55 HL, 90+–251+ TL); *Vityaz* sta. 2707, 910–925 m. IORAS 196 (1 spec.); *Vityaz* sta. 2708, 785–760 m. IORAS 537 (12 spec.); *Vityaz* sta. 2733, 775–750 m. IORAS 197 (5 spec.); *Vityaz* sta. 2734, 850–740 m. CAS 66492 (57 HL, 224+ TL); *Vityaz* sta. 2764, 920–900 m.

**DISTRIBUTION.**— Southeastern Atlantic (off Namibia, South Africa, Discovery Tablemount); Indian Ocean (Walters Shoals, Amsterdam and St-Paul Islands, Mascarene Bank, West Australian Ridge [= Broken Ridge]); about 900–1200 m (Trunov 1984; Iwamoto and Anderson 1994)

**REMARKS.**— A quick comparison of specimens of this species and *C. innotabilis* from Australia and New Zealand revealed no significant difference between them, suggesting a possible synonymy of the nominal species. If so, the species is distributed on both sides of the southern tip of South America, across the South Atlantic and Indian oceans to New Zealand.

#### 7. *Caelorinchus* sp. 1B

**SPECIMENS EXAMINED.**— IORAS 1817 (6 spec.), *Vityaz* sta. 2668, 1010–1010 m. IORAS 535 (14 spec.) and IORAS 1798 (5), *Vityaz* sta. 2671, 1200–1175 m. IORAS 1818 (6) and CAS 66426 (2, 109–123 HL, 370–400+ TL); *Vityaz* sta. 2672, 1310–1265 m. IORAS 520 (2 spec.), *Vityaz* sta. 2736, 1050–630 m.

**DISTRIBUTION.**— Indian Ocean and possibly southwestern Pacific, 1020–1760 m

**REMARKS.**— This is likely to be an undescribed species closely related to *C. labiatus*. It is currently under study.

#### 8. *Cetonurus globiceps* (Vaillant, 1884)

**SPECIMENS EXAMINED.**— IORAS 233 and CAS 66465 (2, 83–94 HL, 330+–380 TL), CAS 66484 (3, 68–79 HL, 294+–305+ TL); *Vityaz* sta. 2672, 1310–1265 m.

**Distribution.**— Widespread in Atlantic, southern Africa, Indian Ocean, southern Australia, and New Zealand, in depths of 970–1600 m (Sazonov and Shcherbachev 1985).

**REMARKS.**— Also recorded from Walters Shoals by Shcherbachev (1987).

#### 9. *Coryphaenoides armatus* Hector, 1874

**DISTRIBUTION.**— Worldwide, usually at depths of about 2,000–4,000 m (Wilson and Waples 1983).

**REMARKS.**— Not taken by *Vityaz*, but recorded by Shcherbachev (1987).

**10. *Coryphaenoides dosseus* McMillan, 1999**

**SPECIMENS EXAMINED.**— IORAS 187 (1, 214 TL); *Vityaz* sta. 2671, 1200–1175 m. IORAS uncat. (1, 24 HL, 141 TL); *Vityaz* sta. 2706, 970–980 m.

**DISTRIBUTION.**— Widespread in southern hemisphere, from eastern South Atlantic, Indian Ocean, Tasman Sea, Coral Sea, in depths of about 700–1600 m, but most commonly in around 900–1200 m.

**REMARKS.**— Additional records are documented in Shcherbachev and Iwamoto (1995:310)

**11. *Coryphaenoides filicauda* Günther, 1878**

**SPECIMENS EXAMINED.**— IORAS uncat. (2, 86+–230 TL); *Vityaz* sta. 2673, 1450–1700 m.

**DISTRIBUTION.**— Circumglobal in southern hemisphere, in depths of about 1600 to more than 5000 m (Iwamoto and Sazonov 1988).

**12. *Coryphaenoides grahami* Iwamoto and Shcherbachev, 1991**

**SPECIMENS EXAMINED.**— CAS 73237 (1 paratype, 55 HL, 340+ TL); 33°56.8'S 45°27.8'E, 1270–1280 m, *Zvezda Kryma* cr. 6, tr. 90, 31 Jul 1976.

**DISTRIBUTION.**— Widespread, from Atlantic off southern Africa, in southern Indian Ocean, and Tasman Sea off southeastern Australia, in depths of 1050–1300 m.

**REMARKS.**— Not taken during *Vityaz* cruise 17, but recorded from Walters Shoals by Iwamoto and Shcherbachev (1991:210) from other vessel collections.

**13. *Coryphaenoides mcmillani* Iwamoto and Shcherbachev, 1991**

**SPECIMENS EXAMINED.**— CAS 73236 (paratype, 45 HL, 225+ TL), *Vityaz* sta. 2670, 1100–1090 m. IORAS 518 (paratype, 32+ HL, 166+ TL), *Vityaz* sta. 2672, 1310–1265 m.

**DISTRIBUTION.**— Southern Ocean from South Atlantic on Whale Ridge (off South Africa) to New Zealand, in 950–1400 m.

**14. *Coryphaenoides murrayi* Günther, 1878**

**SPECIMENS EXAMINED.**— CAS 218976 (1, 21.0 HL, 133 TL); V-2742, 1518–1750 m.

**DISTRIBUTION.**— Western Indian Ocean, southeastern Australia, New Zealand and Fiji, in depths of 1196–2350 m (Iwamoto and Shcherbachev 1991; Iwamoto and Graham 2001).

**15. *Coryphaenoides serrulatus oceanus* Iwamoto and Shcherbachev, 1991**

**SPECIMENS EXAMINED.**— ZISP 49797 (holotype, 89 HL, 482+ TL), IORAS (2 paratypes, 71–89 HL, 402–480+TL) and CAS 66432 (paratype, 54 HL, 303 TL); *Vityaz* sta. 2706, 970–980 m. IORAS 538 (5 spec.), CAS 66468 (7 paratypes, 58–71 HL, 332–415 HL); *Vityaz* sta. 2668, 1010 m. IORAS (116, 240–470); *Vityaz* sta. 2670, 1100–1090 m. IORAS 1799 (5 spec.); *Vityaz* sta. 2671.1200–1175 m. IORAS 539 (1 paratype, 39 HL, 234 TL) and CAS 66481 (1 paratype, 45 HL, 290 TL); *Vityaz* sta. 2707, 910–940 m. CAS 66464 (1 paratype, 56 HL, 282+ TL); *Vityaz* sta. 2764, 920–900 m. IORAS 188 (20 paratypes, 35–66 HL, 213–388 TL); *Vityaz* sta. 2765, 870–880 m. IORAS 189 (1 spec.); *Vityaz* sta. 2767, 240–300 m. ZMMGU P-17638 (56 HL, 337 TL); 33°08'S, 44°15'E. 870–888 m, *FIOLENT* cr. 11, tr. 18, 14 Apr. 1979. ZMMGU P-17655 (82 HL, 420 TL); 32°19'S, 44°30'00"E, 1210–1240 m, *Zvezda Kryma* cr.7, tr. 50, 22 Jan. 1977.



**DISTRIBUTION.**— Widespread, in southern Indian Ocean; 870–1255 m.

**REMARKS.**— Also recorded from Walters Shoals by Shcherbachev (1987) and Iwamoto and Shcherbachev (1991).

**16. *Coryphaenoides striaturus* Barnard, 1925**

**SPECIMENS EXAMINED.**— CAS 66463 (5, 21–71 HL, 95+–398 TL); *Vityaz* sta. 2672, 1310–1265 m. IORAS (4, 28–65 HL, 183–353 TL); *Vityaz* sta. 2673, 1750–1700 m. IORAS 519 (1 spec.); *Vityaz* sta. 2674, 1500–1600 m. CAS 66427 (1, 91 HL, 493 TL), CAS 66428 (1, 54 HL, 303+ TL), IORAS (3, 26–65 HL, 149+–334 TL); *Vityaz* sta. 2742, 1518–1750 m. IORAS (3, 45–57 HL, 245+–341 TL), CAS 66471 (1, 79 HL, 450 TL); *Vityaz* sta. 2772, 1950–2050 m. ZMMGU P-17619 (2, 39–47 HL, 240–280 TL); 32°12'S, 43°15.5'E, 1460–1470 m, *Prof. Mesiatzev* cr. 7, tr. 135, 14 Jun 1979. ZMMGU P-17620 (2, 67–76 HL, 345+–400 TL); 32°19'S, 44°03'E, 1210–1240 m, *Zvezda Kryma* cr. 7, tr. 50, 21 Jan 1977.

**DISTRIBUTION.**— Widespread, from southeastern Atlantic, across southern Indian Ocean, to southern Australia and New Zealand, in depths of 823–2020 m.

**REMARKS.**— A relatively common species, with more Walters Shoals records documented in Iwamoto and Shcherbachev (1991).

**17. *Haplomacrourus nudirostris* Trunov, 1980**

**SPECIMENS EXAMINED.**— CAS 66501 (1 juvenile); *Vityaz* sta. 2670, 1100–1090 m

**DISTRIBUTION.**— Southern hemisphere from southwest coast of Africa, through Indian Ocean to Australia, and into western South Pacific off New Zealand and New Caledonia, in about 800–1600 m (Iwamoto and Graham 2001:473).

**18. *Kuronezumia bubonis* (Iwamoto, 1974)**

**SPECIMENS EXAMINED.**— CAS 66502 (1, 45 HL, 258+ TL spec.); *Vityaz* sta. 2721, 1000–1030 m.

**DISTRIBUTION.**— Widespread in tropical to subtropical waters of western Atlantic, Hawaii, South China Sea, southern Indian Ocean, New Zealand, and eastern Australia (Iwamoto and Graham 2001).

**19. *Malacocephalus laevis* (Lowe, 1843)**

**SPECIMENS EXAMINED.**— CAS 66509 (1, 43 HL, 305+ TL); *Vityaz* sta. 2706, 970–980 m. MNHN 2000–175 (51 HL, 290+ TL); 33°11.4'S, 44°00.4'E, 620–635 m, *Marion-Dufresne* sta. C, cr. MD08, CP47, 16 March 1976.

**DISTRIBUTION.**— Worldwide in tropical to temperate seas in about 200–1000 m (Iwamoto and Graham 2001).

**20. *Mesobius antipodum* Hubbs and Iwamoto, 1977**

**SPECIMEN EXAMINED.**— ZMMGU P.14717 (1, 108 HL, 513+ TL); 32°25'S, 43°46.4'E, 1030 m.

**DISTRIBUTION.**— Cool temperate waters from South Atlantic to southern Australia and New Zealand, in 700–1300 m (Iwamoto and Graham 2001).

**REMARKS.**— Not taken by *Vityaz*; recorded by Shcherbachev (1987) and Shcherbachev et al. (1979).

### 21. *Odontomacrus murrayi* Norman, 1939

**DISTRIBUTION.**— Atlantic and Indo-West Pacific; bathypelagic, in depths from 300 m to more than 2000 m (Parin et al., 1993).

**REMARKS.**— Not taken by *Vityaz'*; recorded by Shcherbachev (1987).

### 22. *Sphagemacrus pumiliceps* (Alcock, 1894)

**SPECIMENS EXAMINED.**— IORAS 542 (1 spec.); *Vityaz* sta. 2672, 1310–1265 m.

**DISTRIBUTION.**— Widespread in Indo-West Pacific in 500–1840 m (Iwamoto and Graham 2001).

## DISCUSSION

### The *Caelorinchus fasciatus* Group

All species of the *Caelorinchus fasciatus* species group (to which *C. vityazae* belongs) are residents of the subtropical and subantarctic (warm-temperate and antiboreal, respectively, of Ekman, 1953) waters of the southern hemisphere. Their distribution patterns more or less coincide with the West Wind Drift (or Circumpolar) current that encircles the globe at mid to high latitudes of the Southern Ocean. The depth distributions of these *Caelorinchus* species are shallow for grenadiers, with a few found occasionally in shallow coastal waters as well as along the outer shelf and upper continental slope. *Caelorinchus biclinozonalis*, for example, has been recorded from only four meters depth (Arai and McMillan, 1982), *C. aspercephalus* from depths as shallow as 33 m, and *C. australis* from 37 m (McCann and McKnight 1980). *C. aspercephalus* has what is possibly the shallowest depth range of all grenadiers, 33–335 m. None of the species of this clade are known from depths beyond 1000 m. These rather limited depth distributions doubtlessly subject members of this clade to much the same environmental factors that affect other shallow-water marine organisms of mid- to high-latitude waters of the southern hemisphere. It is, therefore, not surprising that most of the *C. fasciatus* species group have relatively limited geographic distributions that show general concordance with surface water masses.

*Caelorinchus simorhynchus* is the sole African member of the clade, having a distribution from Namibia (19°52'S, 12°20'E) in the Atlantic, south around the Cape of Good Hope to off Cape St. Francis (34°54'S, 24°18'E) in the Indian Ocean. *C. fasciatus* has the broadest distribution, from the southwestern Atlantic west to New Zealand and Australia. It is known from off both sides of the southern tip of South America, from off Chile (41°40'S) south and east across the Straits of Magellan (at about 53°S) to the Falkland Islands (about 53°S, 31°W), and north along the Patagonian coast of Argentina. The species is known from off the South Island of New Zealand and only off the southeastern coast of Australia (despite published records to the contrary; see Iwamoto and Graham 2001:443). The 10 remaining species (of 14) are found in Australia and New Zealand. Four of these are endemic to New Zealand: *C. biclinozonalis*, *C. bollonsi*, *C. cookianus*, and *C. mystax*, with *C. parvifasciatus* possible a fifth species (see Iwamoto and Graham 2001:454). There are four (and possibly five) species endemic to Australia: *C. amydrozosterus* (western Australia), *C. australis* (southeastern Australia, including NSW, Tas., Vic., and SA), an undescribed species from WA, and *C. mirus* (east, south and west coasts: Qld., NSW, Tas., Vic., SA, and WA). A population of *C. parvifasciatus* that is possibly different from that of New Zealand is confined to southeastern Australia (NSW, Tas., Vic.). *C. maurofasciatus* is widespread across southern Australia (WA, SA, Vic., Tas., NSW) and New Zealand. Thus, rather surprisingly, only two and possibly three species of the group are common to both Australia and New Zealand. The large number of

species (more than 100) in the genus and the relatively limited distributions of most suggest that historical and environmental factors that led to speciation events within the grenadiers have had a greater effect on *Caelorinchus* than in any other of the 30 plus grenadier genera.

### Biogeographical Affinities of Walters Shoals Grenadiers

Duhamel (1999:fig. 2) sketched a zone of biogeographic affinities in the neretic ichthyofauna that stretches in a narrow band across the southern hemisphere. Included in this zone is the WWD Island Province. That Walters Shoals is part of the WWD Island Province is somewhat anomalous in that the seamount is not in itself within the waters of the West Wind Drift, but is instead bathed by the warm, south-to-southwestwardly-flowing waters of the subtropical branch of the South Equatorial Current (see Fig. 3). Water temperatures of 19–23°C in the austral summer were recorded over Walters Shoals by Collette and Parin (1991) during the *Vityaz* cruise, categorizing the waters as distinctly warmer than those off islands typical of the Province (Duhamel, *in litt.*, January 2004). The shoals lie well to the north of the Subtropical Convergence (STC) (see Fig. 3), which defines the northern boundary of the West Wind Drift and more or less coincides with the 14–15°C surface isotherms during summer and 10–12°C during winter (Ekman 1953:212). The shoals are probably affected by the seasonal and yearly oscillations of the boundary. Despite these counter-intuitive factors, Walters Shoals maintains a strong West Wind Drift element to its fauna. Collette and Parin (1991) found 35–40% of the shallow-water fish fauna of Walters Shoals to be endemic to the WWD Island Province; the primary affinities appeared to be with subtropical faunas, and to a lesser extent, to tropical ones. Parin et al. (1993) took a broader look at the shallow-water fauna, including in their analysis the invertebrates as well as fish. They concluded that the source faunas for Walters Shoals were tropical western Indian Ocean as well as southernmost South Africa and islands of the West Wind Drift. On the continental slope and in midwaters, they found that subtrop-

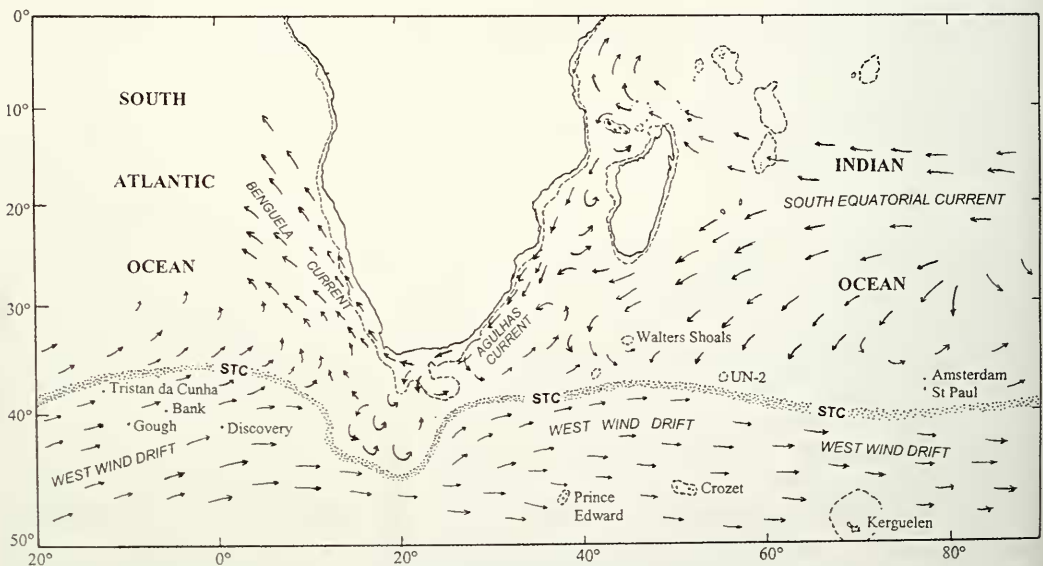


FIGURE 3. Current patterns in the region of the West Wind Drift Islands Province (drawn from various sources). Current patterns and Subtropical Convergence (STC) around southern Africa drawn according to map by Shillington (1986: fig. 4). The Subtropical Convergence roughly follows the 14–15°C summer isotherms (Ekman 1956:212) and separates the warm temperate subtropical region from the cool-temperate subantarctic region.

ical, antitropical, and southern peripheral species predominated. We have found the upper- and mid-slope grenadier fauna of Walters Shoals to be fairly well in accord with those from subtropical and subantarctic water masses of the southern hemisphere. Oscillations of the STC as well as the large counter-clockwise currents that break off from the WWD farther to the east of Walters Shoals and eventually form a gyre that merges with the South Equatorial and Subtropical currents may account for the diversity of the grenadiers of the WWD Island Province. Assuming dispersal by pelagic-stage eggs, larvae, and prejuveniles, it is not difficult to envision settlement onto Walters Shoals of juvenile grenadiers that originated from the WWD water mass. A more-precise delimitation of the water masses with the various distributions of species overlain might provide a better understanding of the causes of these distributions.

Duhamel (1999) recorded and analyzed the deepwater ichthyofauna of Saint Paul and Amsterdam islands from specimens procured by the French vessels *R/V Marion-Dufresne* (July 1986) and *F/V Austral* (July 1996). Of the 48 species in 21 families represented, the Macrouridae was the richest family in terms of species (12 spp.), although not in abundance or biomass, which categories were dominated by berycids and oreosomatids. Duhamel found a high incidence of commonality in the fauna with those from southern Africa (91% in common) and southern Australia and New Zealand (82%), but low (12%) commonality with that from South America.

The Kerguelen and Crozet islands lie farther south than Walters Shoals and other islands of the WWD Island Province, and are inside the Antarctic Convergence (the surface water at Kerguelen in the summer is around 5°C and around 2°C in winter [Ekman 1953:218]). The grenadier composition of these two islands (see Duhamel 1997; Iwamoto 1990b) reflect the Antarctic water and this Southern Ocean location. Of the species Duhamel listed, *Macrourus carinatus* and *Coryphaenoides lecointei* are subantarctic to Antarctic in distribution and were not taken in waters of the WWD Island Province; *Cynomacrus piriei* is a circumglobal bathypelagic species that is generally confined to waters inside of the Antarctic Convergence; and “*Coryphaenoides armatus* and *C. filicauda*, found in common with Walters Shoals, are very deep species which occur worldwide or in the southern hemisphere. The succession of thermic fronts (Subtropical Convergence STC, Subantarctic front and Polar front) separate the WWD province from the Southern Ocean. The species which occur in both regions are only the deep-sea ones, which are not under the influence of surface frontal systems.” (Duhamel, *in litt.* January 2004)

A list of the grenadiers of the WWD Island Province is provided in Table 2. Records for some of the species are based strictly on the literature and may not be accurate, as we have not critically examined all the specimens documenting these distributions. A few changes have been made to the identifications of certain species. *Coryphaenoides carapinus*, for example, is listed here as *C. filicauda*. Specimens from the WWD region appear to be the latter species, based on recent examination of many specimens from southern Australia, but the two are not considered synonyms. *Lucigadus ori* and *L. nigromaculatus* are treated as the same for this table, although they are each still considered distinct (but difficult-to-differentiate) species. The listing of *Coryphaenoides murrai* from Crozet Island is based on MNHN 1985-901 (see Iwamoto 1990b:200, fig. 12), but that identification may not be correct. Walters Shoals has by far the most grenadier species of the Province (22), which probably reflects its geographical position well to the north of other islands of the Province, and perhaps also because it has had more successful trawl hauls made on its slopes.

Walters Shoals grenadiers are compared in Table 3 with those from Amsterdam and St-Paul (ASP), southern Africa, the south coast of Australia (see Gomon et al. 1994), and New Zealand. Eleven of the 14 spp. (or 79% of the spp.) from ASP were also taken off Walters Shoals; this represented 48% of the Walters Shoals grenadiers. It is likely that more collecting off ASP would result in more species found in common, as slope bottoms of oceanic elevations such as represented here

TABLE 2. Tentative list of grenadiers of the West Wind Drift Island Province and Crozet and Kerguelen islands. Records for some of the species are based on the literature and may not be accurate.

	<i>Gough and vicinity</i>	<i>Bank and vicinity</i>	<i>Discovery</i>	<i>Walters Shoals</i>	<i>St. Paul and Amsterdam</i>	<i>Crozet</i>	<i>Kerguelen</i>
<b>Bathygadidae</b>							
<i>Bathygadus cottoides</i>				+			
<i>Bathygadus favosus</i>				+(1)			
<i>Gadomus capensis</i>				+			
<b>Macrouridae</b>							
<i>Asthenomacurus victoris</i>				+			
<i>Caelorinchus kaiyomaru</i>	+(6)	+(8b)	+(8b,9,12)				
<i>Caelorinchus karrerae</i>			+(8b)	+	+(3,11)		
<i>Caelorinchus matamua</i>			+(9)				
<i>Caelorinchus pseudoparallelus</i>		+(8a)	+(8a,9)				
<i>Caelorinchus vityazae</i>	+	+	+(9,12)	+	+(3,11)		
<i>Caelorinchus sp. B</i>			+(8b,12)	+	- ?		
<i>Cetonus globiceps</i>				+(1,10)	+(3,11)		
<i>Coryphaenoides armatus</i>				+(1)		+(14)	
<i>Coryphaenoides dosseus</i>				+(4)	+		
<i>Coryphaenoides fernandezianus</i>							+(3)
<i>Coryphaenoides filicauda</i>				+	+(3,11)	+(3)	+(3)
<i>Coryphaenoides grahmi</i>				+(5)			
<i>Coryphaenoides lecoointei</i>							+(3)
<i>Coryphaenoides mcmillani</i>				+(5)	+(3,11)		
<i>Coryphaenoides mediterraneus?</i>					+(3,11)		
<i>Coryphaenoides murrayi</i>				+		+(3)	+(3)
<i>Coryphaenoides serrulatus</i>				+(1,5)	+(3,11)		
<i>Coryphaenoides striaturus</i>			+(12)	+(1,5)	+		
<i>Cynomacrurus piriei</i>			+(9)				+(13)
<i>Haplomacrurus nudirostris</i>		+(6)		+(10)			
<i>Kumba maculisquamis</i>		+(7)					
<i>Kuronezumia bubonis</i>				+(1)			
<i>Kuronezumia leonis</i>			+(9)				
<i>Lucigadus ori/nigromaculatus</i>					+(3,11)		
<i>Macrurus carinatus/holotrachys</i>			+(9,12)			+(3)	+(3)
<i>Malacocephalus laevis</i>				+(1)	+(11)		
<i>Mesobius antipodum</i>			+(9)	+(1,2)	+(11)		
<i>Nezumia propinqua?</i>					+(3,11)		
<i>Odontomacrurus murrayi</i>				+(1)	+(11)		
<i>Sphagemacrurus pumiliceps</i>				+(1)			

TABLE 3. Number of grenadier species from Walters Shoals (WS) found in common with southern Africa (So. Afr.), Amsterdam and Saint Paul islands (A &amp; SP), south coast of Australia (So. Austr.), and New Zealand (New Zeal.).

	<i>So. Afr.</i>	<i>A &amp; SP</i>	<i>So. Austr.</i>	<i>New Zeal.</i>
<i>Family Bathygadidae</i>				
<i>Bathygadus cottoides</i>	+	-	+	+
<i>Bathygadus favosus</i>	+	-	-	-
<i>Gadomus capensis</i>	+	-	-	-
<i>Family Macrouridae</i>				
<i>Asthenomacrus victoris</i>	-	-	-	+
<i>Caelorinchus innotabilis/karrerae</i>	+	+	+	+
<i>Caelorinchus vityazae</i>	-	+	-	-
<i>Caelorinchus sp. B</i>	-	-	-	+?
<i>Cetomurus globiceps</i>	+	+	+	+
<i>Coryphaenoides armatus</i>	+	-	-	+
<i>Coryphaenoides dosseus</i>	+	+	+	+
<i>Coryphaenoides carapinus/filicauda</i>	+	+	+	+
<i>Coryphaenoides grahami</i>	+	-	-	+
<i>Coryphaenoides mcmillani</i>	+	+	-	+
<i>Coryphaenoides murrayi</i>	-	-	+	+
<i>Coryphaenoides serrulatus</i>	-	+	+	+
<i>Coryphaenoides striaturus</i>	+	+	+	+
<i>Haplomacrus nudirostris</i>	+	-	+	+
<i>Kuronezumia bubonis</i>	+	-	-	+
<i>Malacocephalus laevis</i>	+	+	+	+
<i>Mesobius antipodum</i>	+	+	+	+
<i>Odontomacrus murrayi</i>	+	+	+	+
<i>Sphagemacrus pumiliceps?</i>	+	-	-	-
<i>No. of grenadiers in fauna</i>	46	14	40	73
<i>No. of species in common</i>	17	11	12	18
<i>WS spp. represented (%)</i>	77%	48%	52%	82%
<i>% WS spp. in fauna</i>	37%	79%	30%	25%

FOOTNOTE REFERENCES FOR TABLE 2 (left). (1) Shcherbachev (1987); (2) Shcherbachev, Sazonov and Piotrovsky (1979); (3) Duhamel (1997), except *C. dosseus*, *C. striaturus* and *Nezumia* sp.; *C. murrayi* from Crozet as *Coryphaenoides* sp.; (4) Shcherbachev and Iwamoto (1995); (5) Iwamoto and Shcherbachev (1991); (6) Trunov (1980); (7) Trunov (1981); (8) Trunov (1984); (9) Trunov (1986); (10) Iwamoto and Anderson (1994); (11) Duhamel (1999); (12) Golovan and Pakhorukov (1983); *Caelorinchus* sp. B as *C. occa*; (13) Duhamel, *in litt.*, January 2004; (14) Iwamoto (1990b).

are notably difficult to trawl. Duhamel (1999:189) remarked on the "low number of successful trawls (26) in relation to the high number of damaged nets (five broken beams and falled [sic.] nets; all bottom trawls stopped after less than ten minutes)." It is likely that completion of many more successful hauls in both areas will result in a higher percentage of species in common. As might be expected, the list showed a high commonality of the species with the moderate-sized fauna (46 spp.) of southern Africa — 17 of the 23 Walters Shoals spp. (77%) in common. Two WWD Island Province species not also found off southern Africa may be endemic to the Province — *Caelorinchus vityazae* and possibly the *Nezumia* sp. cf. *propinqua* taken by the *Marion Dufresne*. There was markedly less commonality with the moderate-sized fauna from the south coast of Australia (12 of 40 spp., or 30%). If the grenadiers from Tasmania and New South Wales were also included with those from the south coast of Australia, there would have been a much higher percentage in common with the grenadiers of Walters Shoals. Surprisingly, New Zealand had 82% (18 spp.) of the Walters Shoals grenadiers represented, although those 18 spp. constituted less than one-quarter of that large fauna of about 73 spp. The more southerly position of New Zealand as compared with Australia's south coast may account for the pronounced difference, in that the WWD impinges more directly onto the former area.

That many of the shallow-water fishes of Walters Shoals are also found off the islands Tristan da Cunha, Gough, Saint Paul and Amsterdam, and the seamount UN-2 (= Austral Seamount) seems somewhat perplexing. A logical explanation is that they are located within the northern oscillatory region of the WWD and therefore have been subjected to elements of subtropical as well as subantarctic faunas. These conditions probably obtain with the grenadier fishes of Walters Shoals and Amsterdam and St. Paul islands (see Duhamel 1999), which reflect mixed provenances. The grenadiers of the WWD Island Province are predominantly widespread subtropical, worldwide, or confined to the southern hemisphere; examples of the last are *Caelorinchus karrerae*, *Coryphaenoides dosseus*, *C. striatulus*, *C. grahami*, *C. mcmillani*, and *Kuronezumia leonis*. A smaller group of species is more or less confined to waters of the WWD (*Coryphaenoides murrayi*, *C. subserrulatus*, *Caelorinchus kaiyomaru*). One Walters Shoals species (*Gadomus capensis*) is otherwise known only from southern Africa (see Iwamoto and Anderson, 1994), whereas a second species (*Lucigadus ori*) is known only from southern Africa and southwestern Australia (one specimen; see Iwamoto and Williams, 1999). Among grenadiers, only the new *Caelorinchus* and a possible new *Nezumia* species from Amsterdam Island appear to be endemic to the WWD Island Province, so far as current collections reveal. It is apparent that much more collecting in this faunistically interesting region, especially in the southeastern Atlantic around Tristan da Cunha, Bank Gulf, and Gough, will be necessary before we will be able to come to a more thorough understanding of its biogeography.

## CONCLUSION

Walters Shoals has the most diverse grenadier fauna of all islands and seamounts of the WWD Island Province. Its diversity is attributed to its location well to the north of the Subtropical Convergence where its surface waters are primarily of subtropical origin. That it contains a significant WWD component to its grenadier fauna may be a result of oscillations within the WWD and to dispersal via the current by long-lived pelagic grenadier eggs and larvae. The faunal nexus among grenadiers between the oceanic elevations of the WWD Island Province is supported by the presence of *Caelorinchus vityazae* in five of these elevations. This new species belongs to a species group within the large genus *Caelorinchus*, whose members are almost solely confined to waters in or immediately north of the WWD. The broad connection between grenadiers across the mid to

higher latitudes of the southern hemisphere, from the South Atlantic to New Zealand, is seen by the relatively high commonality of the faunas of widely separated regions bathed by the waters of the WWD.

#### ACKNOWLEDGMENTS

Special thanks to M. Eric Anderson (South African Institute for Aquatic Biodiversity) for his efforts in collecting grenadiers during *Vityaz* cruise 17 and to N.V. Parin for making the IORAS collections available for study. I thank the following for information, assistance during visits, and specimen loans: the late V.V. Barsukov and A.V. Nyelov (ZISP); Guy Duhamel and Patrice Pruvost (MNHN); Christine Thacker and Richard F. Feeney (LACM); Emma Karamovskaya (IORAS); Susan Jewett (USNM). Mysi Hoang and Alan Leviton (CAS) assisted with digital images. I am grateful for the sage reviews of the manuscript by Bruce B. Collette (USNM) and Guy Duhamel; their comments, criticisms, and corrections greatly improved the paper.

#### LITERATURE CITED

- ARAI, T., AND P.J. McMILLAN. 1982. A new macrourid fish, *Coelorinchus bichinozonalis*, from New Zealand, and redescription of *C. australis* from Australia. *Japanese Journal of Ichthyology* 29(2):115–126.
- COLLETTE, B.B. AND N.V. PARIN. 1991. Shallow-water fishes of Walters Shoals, Madagascar Ridge. *Bulletin of Marine Science* 48(1):1–22.
- DUHAMEL, G. 1984. Ichtyofaune d'un haut-fond (34°54'S, 53°14'E) de l'océan Indien sud-ouest. *Cybium* 8(4):91–94.
- DUHAMEL, G. 1997. L'ichtyofaune des îles australes françaises de l'océan Indien. *Cybium* 21(1) suppl.: 147–168.
- DUHAMEL, G. 1999. Deep-sea demersal ichthyofauna off the St-Paul and Amsterdam islands (central southern Indian Ocean). Pages 185–194 in B. Séret and J.-Y. Sire, eds., *Proceedings of the 5th Indo-Pacific Fish Conference (Nouméa, 3–8 November 1997)*. Société Française d'Ichtyologie & Institut de Recherche pour le Développement, Paris. 888 pp.
- EKMAN, S. 1953. *Zoogeography of the Sea*. Sidgwick and Jackson, Dublin, Ireland. 417 pp.
- ESCHMEYER, W.N. 1998. *Catalog of Fishes*. California Academy of Sciences, San Francisco. 2905 pp.
- GILBERT, C.H., AND C.L. HUBBS. 1916. Report on the Japanese macrourid fishes collected by the United States fisheries steamer "Albatross" in 1906, with a synopsis of the genera. *Proceedings of the United States National Museum* 51:135–214, pls. 8–11.
- GOLOVAN, G.A., AND N.P. PAKHORUKOV. 1983. The composition of the demersal ichthyofauna of the Discovery Tablemount. *Journal of Ichthyology* 23(1):13–19.
- GOMON, M.F., J.C.M. GLOVER AND R.H. KUITER, eds. 1994. *The Fishes of Australia's South Coast*. State Print, Adelaide, Australia. 992 pp.
- IWAMOTO, T. 1970. The R/V Pillsbury Deep-Sea Biological Expedition to the Gulf of Guinea, 1964–65.19. Macrourid fishes of the Gulf of Guinea. *Studies in Tropical Oceanography, Miami* (4)(pt. 2):316–431.
- IWAMOTO, T. 1990a. Macrouridae. Pages 90–317 in D.M. COHEN, T. INADA, T. IWAMOTO, AND N. SCIALABBA, *FAO Species Catalogue, vol. 10. Gadiform Fishes of the World. An Annotated and Illustrated Catalogue of Cods, Hakes, Grenadiers and Other Gadiform Fishes Known to Date*. FAO, Rome. 442 pp.
- IWAMOTO, T. 1990b. Macrouridae, Grenadiers. Pages 192–206 in O. Gon and P.C. Heemstra, *Fishes of the Southern Ocean*. J.L.B. Institute of Ichthyology, Grahamstown, South Africa. 462 pp., 12 pls.
- IWAMOTO, T. AND M.E. ANDERSON. 1994. Review of the Grenadiers (Teleostei: Gadiformes) of Southern Africa, with Descriptions of Four New Species. *J.L.B. Smith Institute of Ichthyology, Ichthyological Bulletin* (61). 28 pp.
- IWAMOTO, T., AND K.J. GRAHAM. 2001. Grenadiers (families Bathygadidae and Macrouridae, Gadiformes, Pisces) of New South Wales, Australia. *Proceedings of the California Academy of Sciences* 52(21):407–509.



- IWAMOTO, T., P. McMILLAN AND Y.N. SHCHERBACHEV. 1999. A new grenadier, genus *Caelorinchus*, from Australia and New Zealand (Pisces, Gadiformes, Macrouridae). *New Zealand Journal of Marine and Freshwater Research* 33(1):49–54.
- IWAMOTO, T., AND N.R. MERRETT. 1997. Pisces Gadiformes: taxonomy of grenadiers of the New Caledonian region, southwest Pacific. Pages 473–570 in A. Crosnier, ed., *Résultats des Campagnes MUSORSTOM*, vol. 18. Mémoire du Muséum National d'Histoire Naturelle, Paris no. 176
- IWAMOTO, T., AND Y.I. SAZONOV. 1988. A review of the southeastern Pacific *Coryphaenoides* (*sensu lato*) (Pisces, Gadiformes, Macrouridae). *Proceedings of the California Academy of Sciences* 45(3):35–82.
- IWAMOTO, T., AND Y.N. SHCHERBACHEV. 1991. Macrourid fishes of the subgenus *Chalinura*, genus *Coryphaenoides*, from the Indian Ocean. *Proceedings of the California Academy of Sciences* 47(7):207–233.
- IWAMOTO, T., AND A. WILLIAMS. 1999. Grenadiers (Pisces, Gadiformes) from the continental slope of western and northwestern Australia. *Proceedings of the California Academy of Sciences* 51(3):105–243.
- LEVITON, A.E., AND R.H. GIBBS, JR. 1988. Standards in herpetology and ichthyology. Standard symbolic codes for institution resource collections in herpetology and ichthyology. Supplement No. 1: Additions and corrections. *Copeia* 1988(1):282.
- LEVITON, A.E., R.H. GIBBS, JR., E. HEAL, AND C.E. DAWSON. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia* 1985(3):802–832.
- MCCANN, C., AND D.G. MCKNIGHT. 1980. The marine fauna of New Zealand: macrourid fishes (Pisces: Gadida). *New Zealand Oceanographic Institute Memoirs* 61:1–91.
- McMILLAN, P.J., AND C.D. PAULIN. 1993. Descriptions of nine new species of rattails of the genus *Caelorinchus* (Pisces, Macrouridae) from New Zealand. *Copeia* 1993(3): 819–840.
- PARIN, N.V., K.N. NESIS, A.Y. SAGAIACHNY, AND Y.N. SHCHERBACHEV. 1993. Fauna of Walters Shoals, a seamount in the southwestern Indian Ocean. *Trudy Instituta Okeanologii* 128:199–216. (In Russian.)
- SAZONOV, Y.I., AND Y.N. SHCHERBACHEV. 1985. Preliminary review of grenadiers of the *Cetomurus* group (Gadiformes, Macrouridae). II. The genus *Cetomurus* Günther: taxonomic characters of the group. *Journal of Ichthyology* 25(3):12–26, figs. 1–2, tables 1–2.
- SHCHERBACHEV, Y.N. 1987. Preliminary list of thalassobathyal fishes of the tropical and subtropical waters of the Indian Ocean. *Voprosy Ikhtiologii* 27(1):3–11. (In Russian; English version in *Journal of Ichthyology* 27[2]: 37–46.)
- SHCHERBACHEV, Y.N., AND T. IWAMOTO. 1995. Indian Ocean grenadiers of the subgenus *Coryphaenoides*, genus *Coryphaenoides* (Macrouridae, Gadiformes, Pisces). *Proceedings of the California Academy of Sciences* 48(14):285–314.
- SHCHERBACHEV, Y.N., Y.I. SAZONOV, AND A.S. PIOTROVSKIY. 1979. On the discovery of *Trachonurus villosus* and species of the genus *Mesobius* (Macrouridae, Osteichthyes) in the Indian Ocean. *Journal of Ichthyology* 19(1):16–23.
- SHILLINGTON, F.A. 1986. Oceanography of the southern African region. Pages 22–28 in M.M. Smith and P.C. Heemstra, *Smith's Sea Fishes*. Macmillan South Africa Ltd: Johannesburg, South Africa. 1047 pp.
- TRUNOV, I.A. 1980. A new genus and species of grenadier. *Haplomacronurus mudirostris* gen. et. sp. n. (Osteichthyes, Macrouridae). *Voprosy Ikhtiologii* 20(120):3–11 (In Russian; English translation in *Journal of Ichthyology* 21[1]:27–35 [1981].)
- TRUNOV, I.A. 1981. Ichthyofauna of the submarine bank Valdivia (southeastern Atlantic). *Byul. Mosk. O-va Ispytateley Prirod [Bulletin of the Moscow Society of Naturalists, Biological Series]* 86(5):51–64. (In Russian.)
- TRUNOV, I.A. 1983. On the characteristics of some species of the genus *Coelorinchus* (Macrouridae) from the southeastern Atlantic Ocean. Report 1. *Voprosy Ikhtiologii* 23(6):894–904. (In Russian; English translation in *Journal of Ichthyology* 23[6]:13–23.)
- TRUNOV, I.A. 1984. Characteristics of some species of the genus *Coelorinchus* Giorna (Osteichthyes, Macrouridae) from the southeastern Atlantic Ocean. Report 2. *Voprosy Ikhtiologii* 24(3):355–367. (In Russian; English version in *Journal of Ichthyology* 24[3]:132–145.)

TRUNOV, I.A. 1986. [Rattails (Pisces: Macrouridae) in the area of the Discovery submarine mountain (the south-eastern part of the Atlantic Ocean.) *Byul. Mosk. O-va Ispytateley Prirod* [*Bulletin of the Moscow Society of Naturalists, Biological Series*] 91(2):21–33. (In Russian.)